

SGMA requires that all beneficial uses and users of groundwater, including Groundwater Dependent Ecosystems (GDEs), be considered in Groundwater Sustainability Plans (GSPs) (Water Code § 10723.2).

Each Plan shall provide a description of current and historical groundwater conditions in the basin, including data from January 1, 2015, to current conditions, based on the best available information that includes: Identification of groundwater dependent ecosystems within the basin, utilizing data available from the Department, as specified in Section 353.2, or the best available information (23 CCR § 354.16(g)).<sup>1</sup>

<sup>1</sup>. Section 353.2(B). States, “The Department shall provide information, to the extent available, to assist Agencies in the preparation and implementation of Plans, which shall be posted on the Department’s website.

## Groundwater Dependent Ecosystems

- Groundwater Dependent Ecosystems (GDEs)  
Definition and Types
- Identify and Mapping Potential GDEs
- Characterize Potential GDEs Condition

**DUDEK**

Today's presentation will cover Groundwater Dependent Ecosystems (GDEs) definition and types. Identification and mapping of potential GDEs within the Borrego Springs Groundwater Subbasin (Subbasin) and Preliminary characterization of potential GDEs historical and baseline condition.

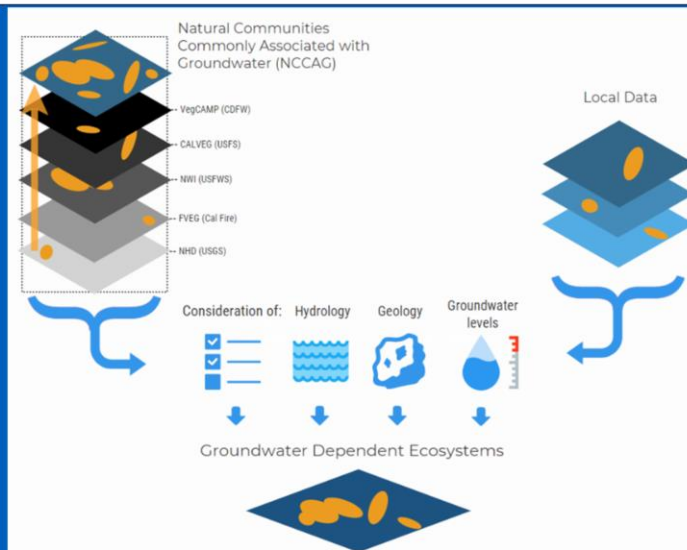
## GDEs Definition and Types

- Groundwater dependent ecosystem (GDEs) are defined under SGMA as “ecological communities of species that depend on groundwater emerging from aquifers or on groundwater occurring near the ground surface” (23 CCR § 351(m)).
- Types of GDEs include, but not limited to the following:
  1. Seeps and Springs
  2. Wetlands and Lakes
  3. Terrestrial Vegetation
  4. Rivers, Streams, and Estuaries

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“A groundwater dependent ecosystem (GDE) is a plant and animal community that requires groundwater to meet some or all water needs” (TNC 2018). GDEs are defined under the Sustainable Groundwater Management Act (SGMA) as “ecological communities or species that depend on groundwater emerging from aquifers or on groundwater occurring near the ground surface” (23 CCR § 351.(m)). GDEs encompass a wide range of natural communities, such as seeps and springs, wetlands and lakes, terrestrial vegetation and, rivers, streams and estuaries.

## Identifying and Mapping GDEs



Source: TNC 2018

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“The Natural Communities [Commonly Associated with Groundwater] dataset is provided by the Department of Water Resources (DWR) as a reference dataset and potential starting point for the identification of GDEs in groundwater basins. The Natural Communities dataset and its source data can be reviewed by GSAs, stakeholders, and their consultants using local information and experience related to the validity of mapped features and understanding of local surface water hydrology, groundwater conditions, and geology . . .” (TNC 2018). The Natural Communities dataset is comprised of 48 publically available state and federal agency mapping datasets including but not limited to the following: VegCAMP – The Vegetation Classification and Mapping Program, California Department of Fish and Wildlife (CDFW); CALVEG – Classification and Assessment with Landsat Of Visible Ecological Groupings, USDA Forest Service; NWI V 2.0 – National Wetlands Inventory (Version 2.0), United States Fish and Wildlife Service; FVEG – California Department of Forestry and Fire Protection, Fire and Resources Assessment Program (CALFIRE FRAP); United States Geologic Survey (USGS) National Hydrography Dataset (NHD); and Mojave Desert Springs and Waterholes (Mojave Desert Spring Survey).

After the vegetation, wetland, seeps, and springs data described above were compiled into the Natural Communities dataset, data were screened to exclude vegetation and wetland types less likely to be associated with groundwater and retain types commonly associated with groundwater. The screening was conducted by DWR, CDFW and the Nature Conservancy (TNC).

## Identifying and Mapping GDEs



- Three primary potential GDEs areas were identified in the Borrego Springs Groundwater Subbasin:
- GDE Unit 1 – Coyote Creek
- GDE Unit 2 – Borrego Palm Creek
- GDE Unit 3 – Mesquite Bosque

### Evaluation of Other Potential GDEs at Subbasin Fringe

- Hellhole Palms
- Tubb Canyon
- Glorietta Canyon
- Others?

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Based on the Natural Communities Dataset provided by the Department of Water Resources, three (3) primary potential groundwater dependent ecosystems (GDEs) areas are mapped within the Subbasin:

GDE Unit 1 – Coyote Creek

GDE Unit 2 – Borrego Palm Creek

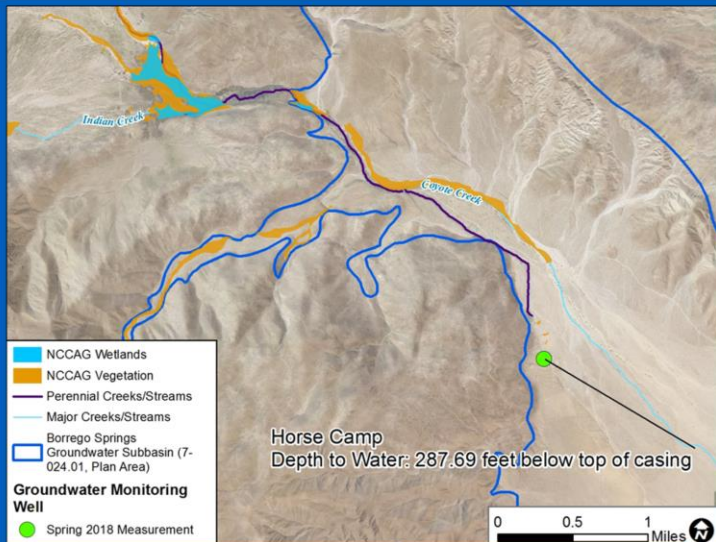
GDE Unit 3 – Mesquite Bosque (Borrego Sink)

Other potential GDEs include but are not limited to Hellhole Palms, Tubb Canyon, Glorietta Canyon and other minor or unnamed stream segments entering the Subbasin as suggested by stakeholders and relevant agencies.

Other potential GDEs will likely require coordination by the GSA with pertinent agencies to identify and map their location. As the GSP is focused on the boundary of the Borrego Springs Subbasin, the potential GDEs should either be located within the Subbasin boundary or be sufficiently approximate to the boundary that a substantial nexus exists with Subbasin groundwater levels and the potential GDEs.

## Identifying and Mapping GDEs Coyote Creek

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Both wetlands and vegetation are mapped in GDE Unit 1, Coyote Creek, according to the Natural Communities [Commonly Associated with Groundwater] dataset. These communities are narrowly focused within the riparian corridors associated with Coyote Creek.

GDE plant type mapped in association with Coyote Creek:

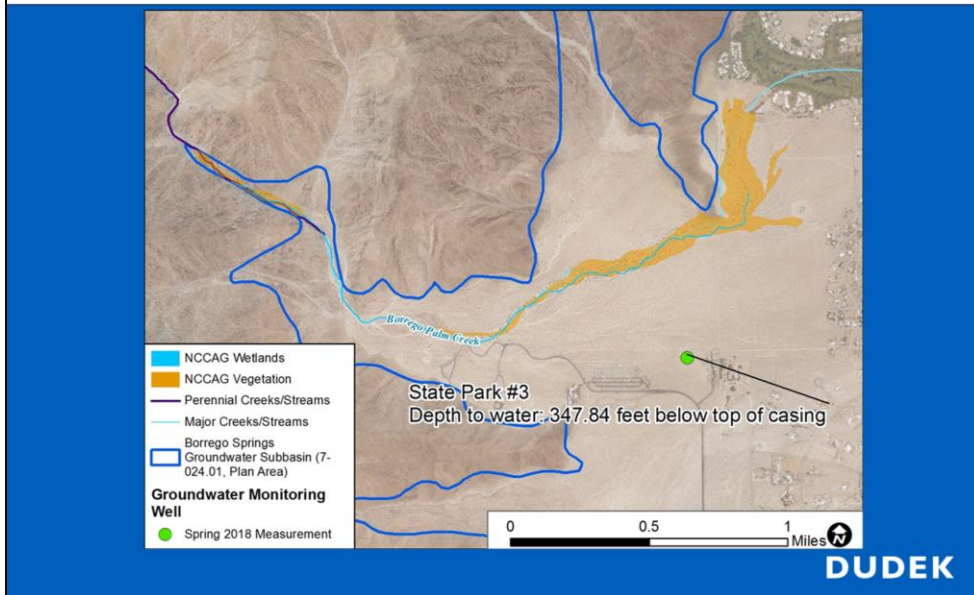
Desert Willow, Narrowleaf Willow, Honey Mesquite and Catclaw Acacia (drought deciduous [lacks leaves for most of the year])

The nearest water well in the Subbasin to the mapped GDEs is the Horse Camp well owned by the State Park. The depth to groundwater at the Horse Camp well is 287.69 feet below top of casing (664.76 ft above MSL) as measured in the Spring of 2018.



## Identifying and Mapping GDEs Palm Canyon

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Primarily vegetation is mapped in GDE Unit 2, Borrego Palm Canyon/Creek, according to the Natural Communities [Commonly Associated with Groundwater] dataset. These communities are narrowly focused within the riparian corridors associated with Palm Creek.

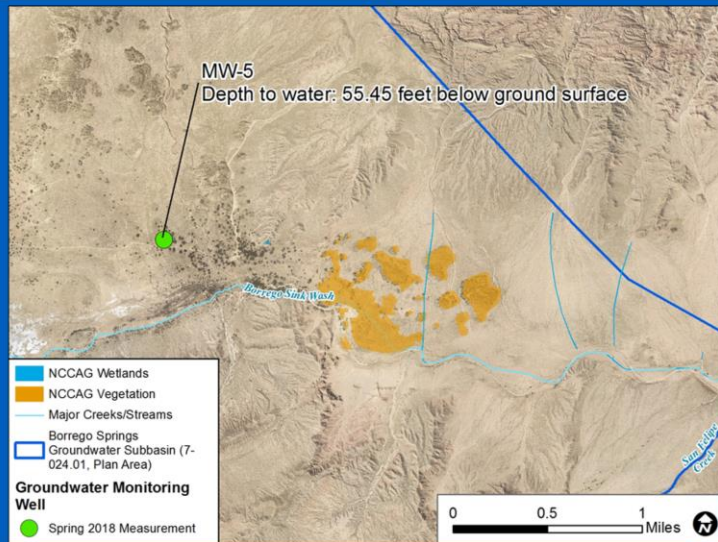
GDE plant types mapped in association with Palm Canyon:

Desert Willow, California Fan Palm, Catclaw Acacia

The nearest water well in the Subbasin to the mapped GDEs with historical groundwater elevation data is the State Park well. The depth to groundwater at the State Park well is 347.84 feet below top of casing (377.16 ft above MSL) as measured in the Spring of 2018.

## Identifying and Mapping GDEs Mesquite Bosque (Borrego Sink)

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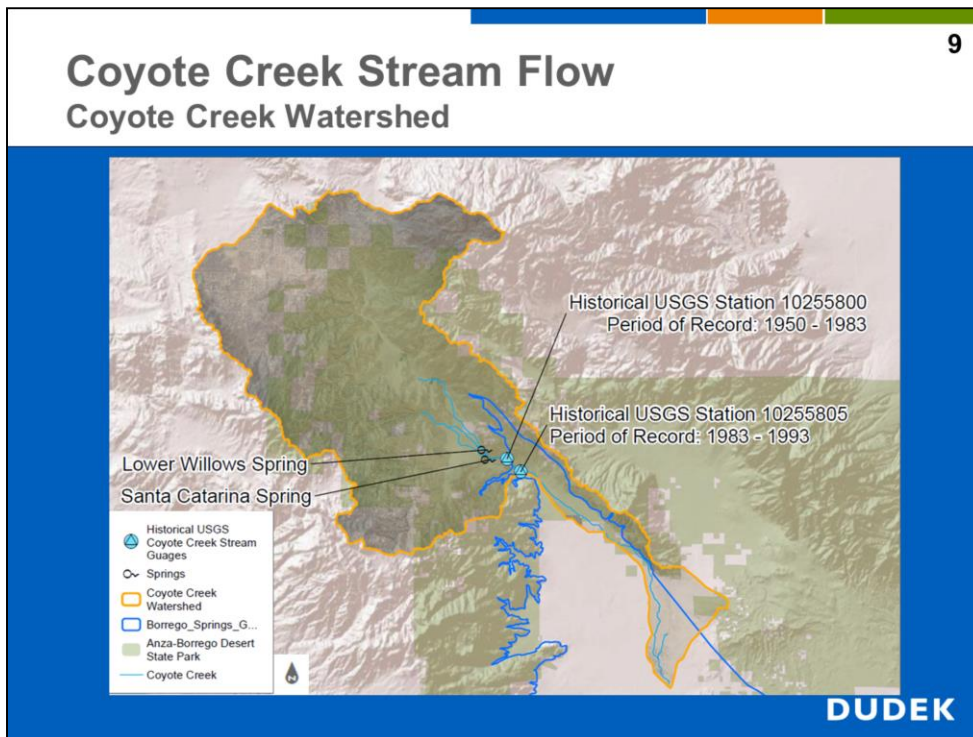


Primarily vegetation is mapped near GDE Unit 3, Mesquite Bosque/ Borrego Sink, according to the Natural Communities [Commonly Associated with Groundwater] dataset. These communities are narrowly focused east of the Borrego Sink.

GDE plant type primarily associated with the Borrego Sink is honey mesquite.

The nearest water well in the Subbasin to the mapped GDEs with historical groundwater elevation data is monitoring well MW-5. The depth to groundwater at monitoring well MW-5 is 55.45 feet below ground surface (409.60 ft below MSL) as measured in the Spring of 2018.





Coyote Creek watershed encompasses approximately 180 square miles as shown by the orange line. The watershed is located almost entirely within the boundary of the Anza Borrego Desert State Park (green shading). Stream flow in the Coyote Creek watershed has been documented by USGS as the number one source of recharge to the Subbasin via stream flow leakage (i.e. infiltration of surface water runoff). 65% of the surface water inflow to the Borrego Valley comes from Coyote Creek (USGS 1982).

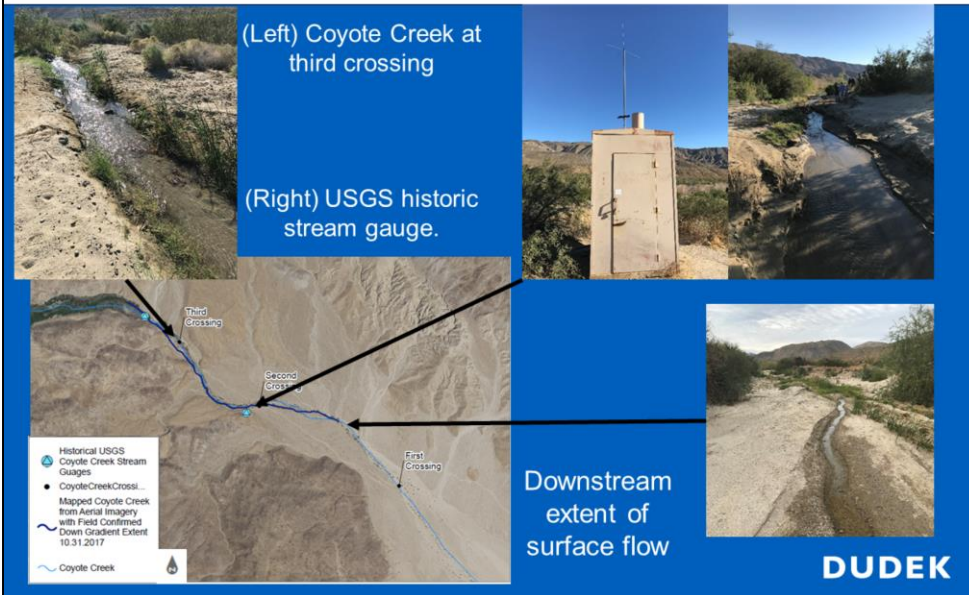
USGS Station Number 1025580 (Upper–Northern) recorded daily discharge data from 1951 – 1983; Annual average stream flow measured = 1,831 acre-feet per year (USGS 2017)

USGS Station Number 10255805 (Lower–Southern) recorded daily discharge data from 1983 – 1993; Annual average stream flow = 1,774 acre-feet per year (USGS 2017).

Annual variability over the period measured ranges from 326 acre-feet to 10,715 acre-feet. This large annual variability is a function of large annual variability of precipitation falling on the Coyote Creek watershed.

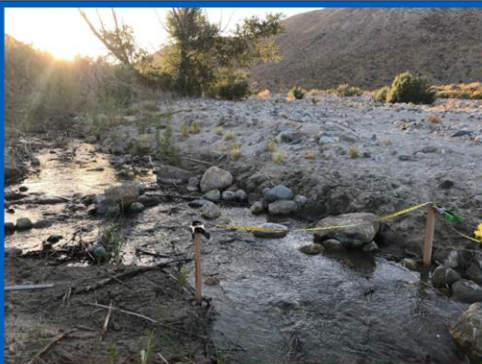
Our working hypothesis is that Coyote Creek stream flow is generally correlated with precipitation and spring discharge from Clark Valley outside and at higher elevation than the Subbasin and is not a result of groundwater discharge emanating from the Borrego Springs Subbasin.

## Coyote Creek Stream Flow Fall 2017



The Lower Historical USGS streamflow station (pictured) still stands but its equipment was destroyed due to the flashy nature of Coyote Creek during high rainfall events. This is the permanent location of one of the GSAs manual stream flow monitoring points. In the fall of 2017, flow in Coyote Creek was observed at this location but no flow was observed in the spring of 2018.

## Coyote Creek Stream Flow Spring 2018



May 2018

0.46 cubic feet per second (206.5 gallons per minute) at upper historical stream gage location (gage no longer active)



May 2018

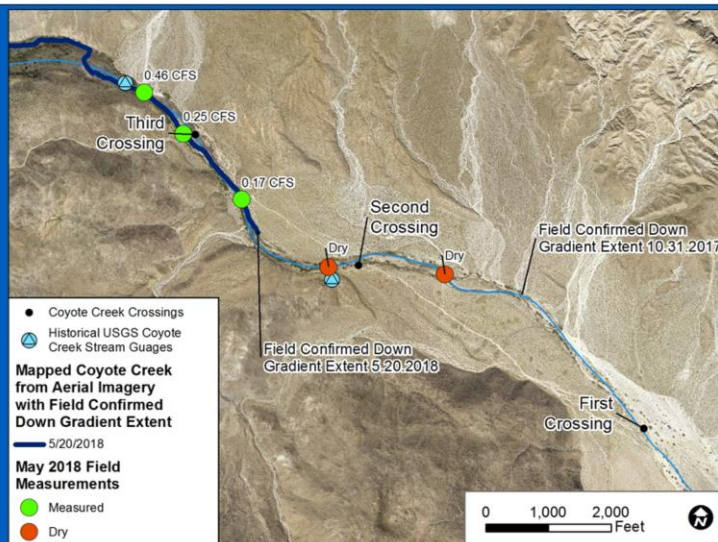
Dry creek at lower stream gauging location

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At the approximate location of the former upper historical USGS stream gage flow of 0.46 cubic feet per second (CFS), which converts to 206.5 gallons per minute was measured in the spring 2018 (manual measurement; upper photograph).

In the Spring of 2018, the location of the former lower historical USGS stream gage station was dry.

## Coyote Creek Stream Flow Spring 2018



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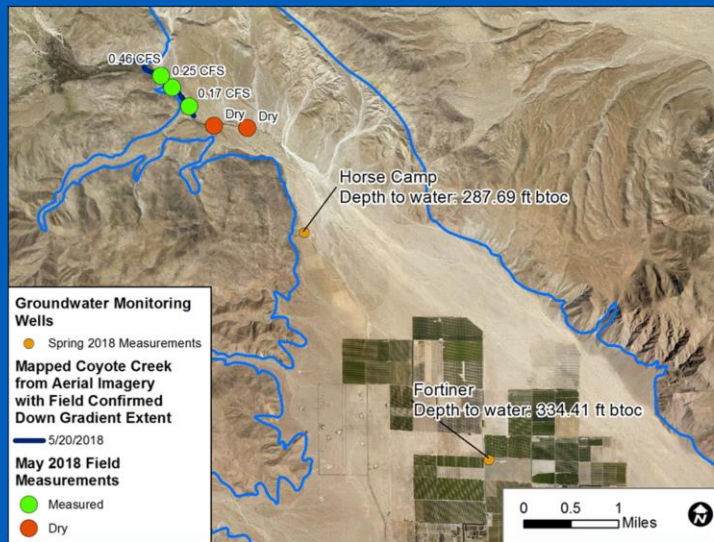
To begin to evaluate the GDEs associated with Coyote Creek, it is important to determine whether the perennial and ephemeral creek segments are gaining water or losing water to the underlying aquifer system. To complete this analysis, the GSA has begun to map the perennial extent of flow in to the Subbasin on a semi-annual basis (Spring and Fall). In addition to mapping the perennial extent of flow, the GSA is manually measuring stream flow at several established locations. In the fall of 2017, stream flow extended almost half-way from the second crossing to the first crossing. The crossings refer to where the unimproved road crosses the creek bed. In the fall of 2017, there was a precipitation event in the Coyote Creek watershed that produced runoff in Coyote Creek; however no stream flow measurements are available for this event. In the spring of 2018, the perennial extent of flow in Coyote Creek was documented to occur downstream of the third-crossing and upstream of the second crossing. No flow was observed in the spring of 2018 at the lower inactive USGS stream gage, which is one of the permanent locations for manual flow readings.

Flow in the stream was observed to decrease incrementally from the upper inactive USGS stream gage to 2 locations measured downstream. This indicates that Coyote Creek is currently a “losing stream” below the upper inactive USGS gage location.



## Coyote Creek Stream Flow and Groundwater Levels Spring 2018

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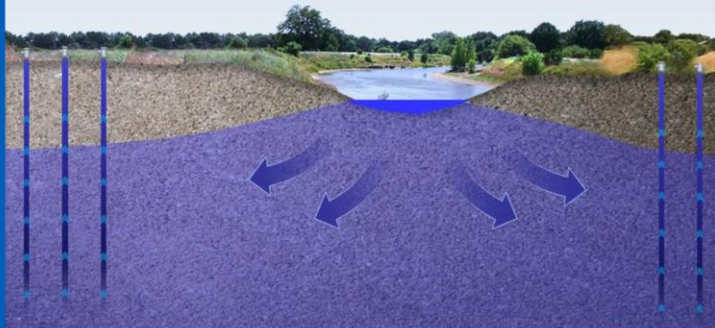


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Perennial stream flow in Coyote Creek is currently observed in the northern most section of the Subbasin (green dots). Groundwater daylights at lower elevations in the Collins Valley at the Oasis at Santa Catarina Spring and Lower Willows Spring where the stream is restricted by a narrow hard rock canyon. The restrictive canyon appears to act as a subsurface dam causing groundwater to daylight at the spring and flow into the Subbasin as surface water flow in Coyote Creek. This occurs at an elevation of about 1,300 feet AMSL. The spring was first documented in 1774 by members of the Anza Expedition near the site of a large Cahuilla Indian village. As the creek flows through the Borrego Springs Subbasin, the alluvium becomes deeper and the surface flow either infiltrates into the Subbasin, is consumed by the riparian vegetation through transpiration and/or evaporates. During high rainfall events, flow extends the creek further into the Subbasin for short periods of time. The principal groundwater surface in the Subbasin as documented by well monitoring is hundreds of feet below the area of GDEs associated with Coyote Creek. The Subbasin alluvial aquifer is likely disconnected from the Coyote Creek GDEs and does not sustain this habitat. The water supply source for the Coyote Creek GDEs comes from the upper portions of the Coyote Creek Watershed. Horse Camp: groundwater elevation 664.76 feet above MSL. Fortiner: groundwater elevation 375.05 feet above MSL.

## Groundwater – Surface Water Connection

### Groundwater – Surface Water Connection Losing Stream



Source: Hall & O'Brien 2018

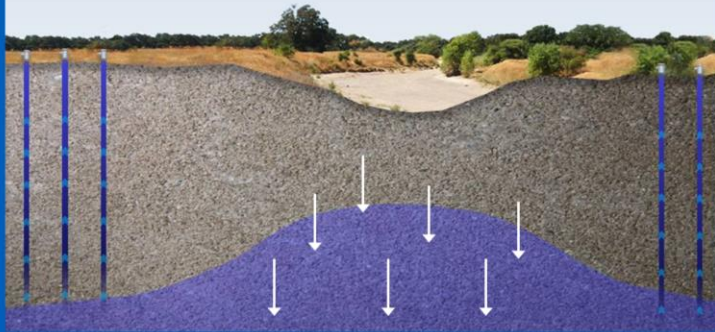
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Coyote Creek is a losing stream as documented by the recent flow readings that indicate diminished flow downstream of the inactive upper USGS stream gage.



## Groundwater – Surface Water Connection

### Groundwater – Surface Water Connection Dry Stream

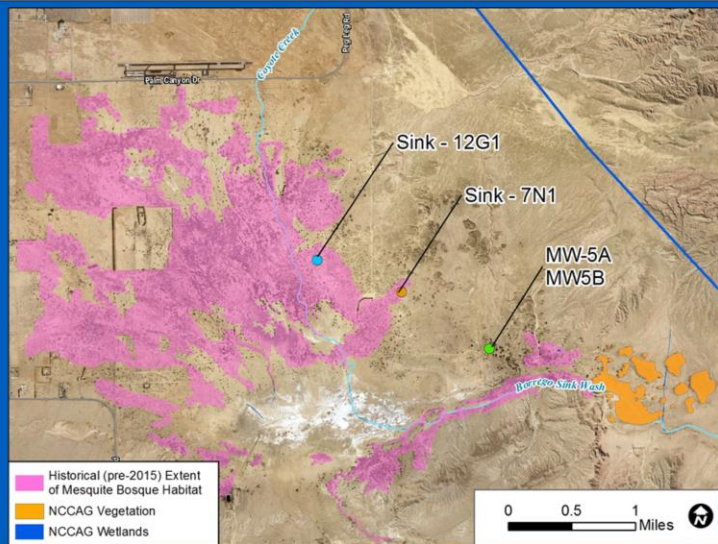


Source: Hall & O'Brien 2018

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Currently, below the lower inactive USGS stream gage Coyote Creek is dry. In the sub-surface, surface water that has percolated in to the alluvial sediments is migrating downward and driven into the Subbasin aquifer under a hydraulic gradient (no water well groundwater level data is available in this part of the aquifer to determine the gradient or definitively determine the quantity of sub-surface inflow into the Subbasin).

## Mesquite Bosque (Borrego Sink)



Source: SANGIS 2017, NCCAG 2018

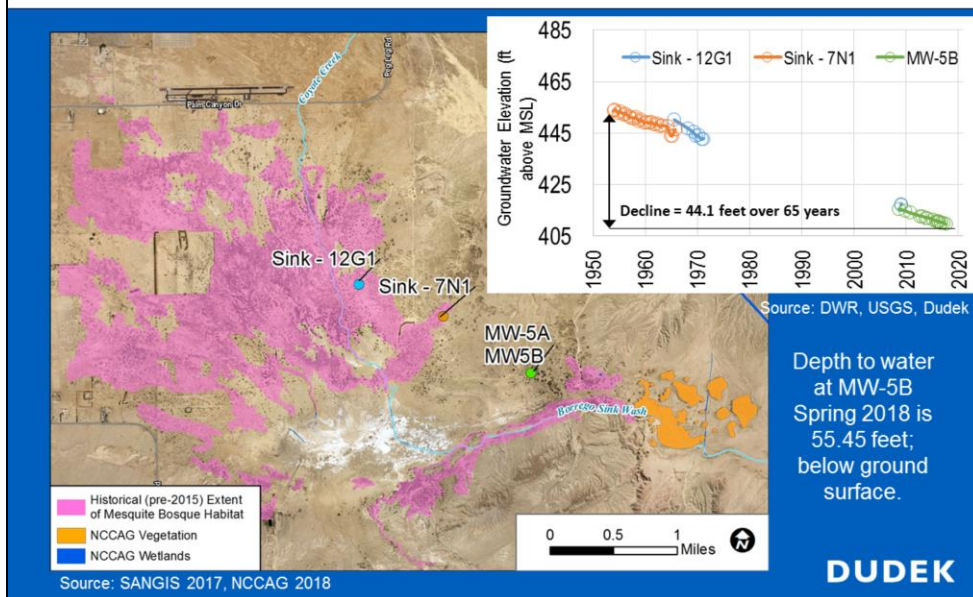
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The Borrego Sink was the site of about 450 acres of honey mesquite and other native phreatophytes, indicating that shallow groundwater and occasional accumulations of surface water was historically sufficient to support a groundwater dependent ecosystem (USGS 2015).

As stated in General Plan Update Groundwater Study completed by San Diego County (2010): “The mesquite bosque, a rare and sensitive groundwater-dependent habitat, is believed by many experts to be desiccating in portions of Borrego Valley, even though their taproots can reach down to 150 feet for water. The habitat covered an approximate four-square mile area. However, while mesquite bosque can have extremely deep taproots, the USGS (2015) notes that the deepest rooting depth for phreatophytes found in around the Borrego Sink and areas to the north was at 15.3 feet. Recent groundwater levels from wells adjacent to the main mapped habitat range from approximately 55 to 134 feet below the ground surface.”

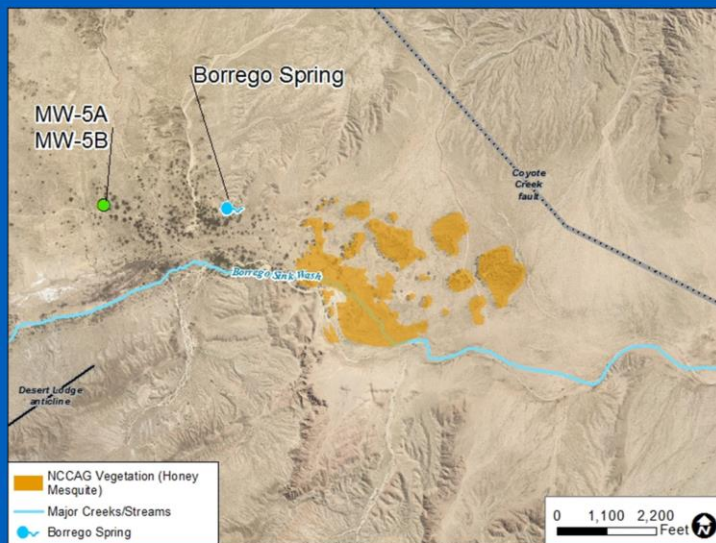
The Natural communities dataset only maps vegetation east of the Borrego Sink as a potential GDEs (orange area). The pre-2015 historical extent of the mesquite bosque is mapped as the pink area (SanGIS 2017).

## Mesquite Bosque (Borrego Sink)



Pumping in the Subbasin has resulted in a groundwater level decline of about 44.1 feet over the last 65 years in the vicinity of the Borrego Sink. The average rate of decline over this 65 year period is approximately 0.67 feet per year. Because of the long-term imbalance of pumping with available natural recharge, an irreversible impact has occurred to the honey mesquite bosque, which is mostly desiccated prior to January 1, 2015. MW-5 is a multi-completion well constructed under the oversight of the Borrego Water District and Department of Water Resources. MW-5B is screened from 45 to 155 feet below ground surface and appears to sufficiently represent the depth of the groundwater table in the vicinity of the Borrego Sink though it is possible that it represents a semi-confined potentiometric surface rather than the unconfined water table. MW-5A is screened from 200 to 340 feet and has a similar groundwater level to the shallower MW-5B suggesting potentially unconfined conditions in this part of the Subbasin; however it is uncertain whether a good well seal was obtained during installation of the multi-completion monitoring well. The “Sink” wells have become dry based on measurements recently performed by DWR. The overlap of a groundwater level measurement in 2009 of Sink Well 12G1 with MW-5B, which has a similar groundwater level elevation suggests that well MW-5B is sufficiently representative of depth to the groundwater table in the area of the Borrego Sink.

## Borrego Spring



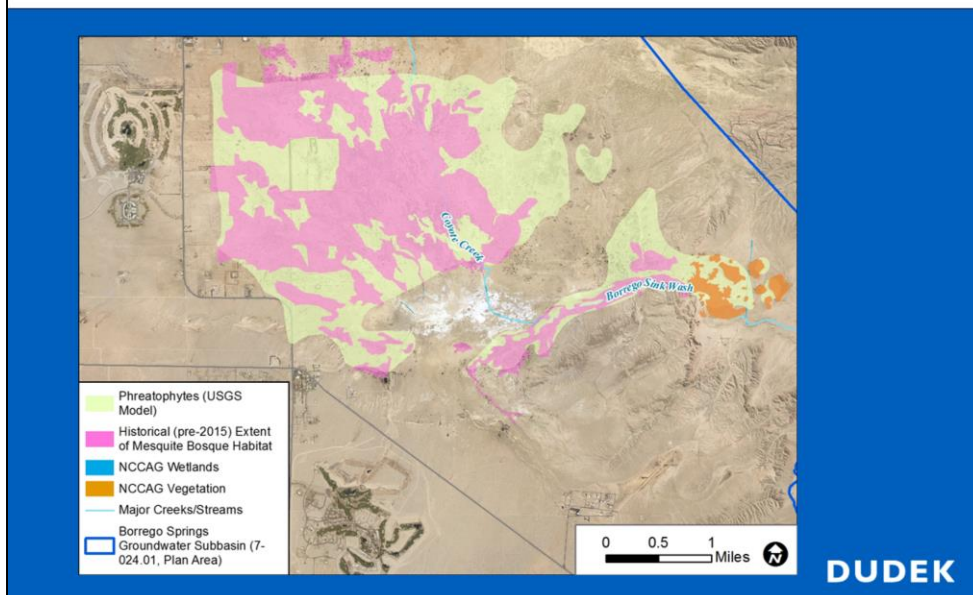
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In 1963, Lester Reed wrote in *Old Time Cattlemen and Other Pioneers of the Anza-Borrego Area*, "Since so much recent pumping of water in the Borrego Valley, the old spring no longer flows. This spring was one of the watering places upon which the Indians, and the old-timers could depend, although the water was of poor quality. The first time I visited Old Borrego Spring was just two or three days before Christmas 1913 when my brother Gilbert (Gib), and I were riding though on horseback from Imperial Valley to spend the holidays with our parents at the Mud Spring Ranch about fifteen miles southeast of Hemet. Since early boyhood, I heard old-timers talk about Borrego Springs water; so I thought I would try it. As I have said many times before, I found it to taste but very little better than the treated water we are expected to drink today."

The Borrego Spring was located in the vicinity of the Desert Lodge anticline, fold axes running perpendicular to the Veggie Line fault (notice uplifted and sediments located south of the Borrego Spring and mapped natural communities vegetation), Coyote Creek fault and Yaqui Ridge/San Felipe anticline associated with the San Jacinto fault zone (Steely 2009). The faulting and folding effectively compartmentalize the deep sediments of the Borrego Springs Groundwater Subbasin and likely once resulted in 'daylighting' of groundwater at the Borrego Sink prior to interception of groundwater flow by pumping.



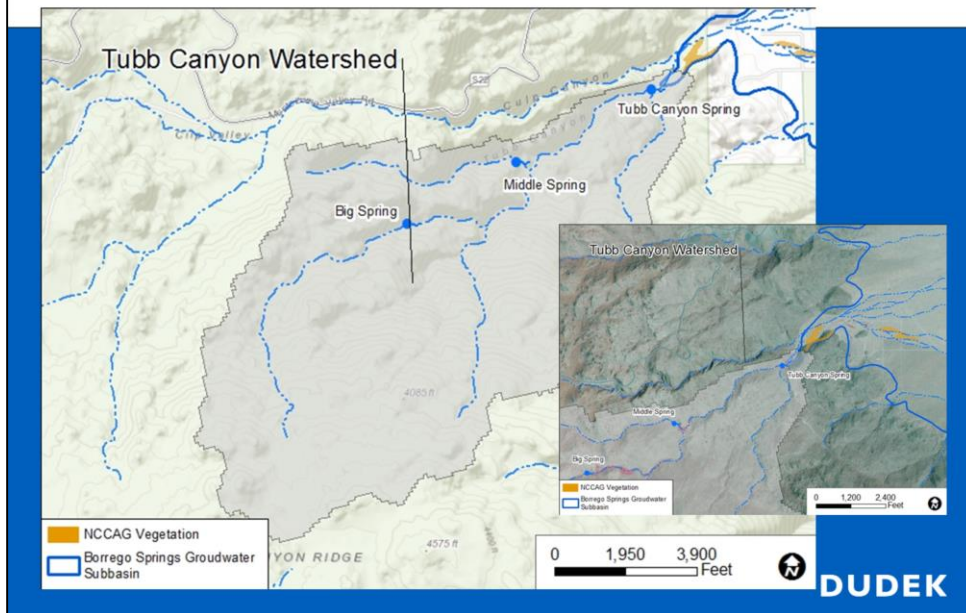
## Phreatophytes



Phreatophytes are long-rooted water loving plants that obtain water supply from groundwater or the capillary fringe just above the water table. Prior to development, mesquite tress, salt grass, willow and rushes were reported to be abundant in the valley (Mendenhall 1909). The Borrego sink, a topographic low where the water table was within 10 feet of land surface, once sustained a thriving stand of mesquite and other phreatophytes. Mitten (1988) and other estimated that prior to 1946, about 4,300 acre-feet of water was discharged from phreatophytes annually by evapotranspiration. Today, it is estimated that only a few hundred acre-feet per year is used by phreatophytes including invasive tamarisk.

The green area depicts the pre-pumping mapped historical extent of phreatophytes in the Subbasin by USGS (USGS 2015). The pink area depicts the mapped pre-January 1, 2015 extent of potential groundwater dependent ecosystems (GDEs); (SANGIS 2017) and the orange are depicts the extent of mapped GDEs by the natural communities dataset (DWR 2018).

## Potential GDEs – Tubb Canyon



Tubb Canyon is a 2,396 acre watershed that discharges through a narrow canyon to the Subbasin where it broadens into a bajada (a broad slope of alluvial material at the foot of an escarpment or mountain).

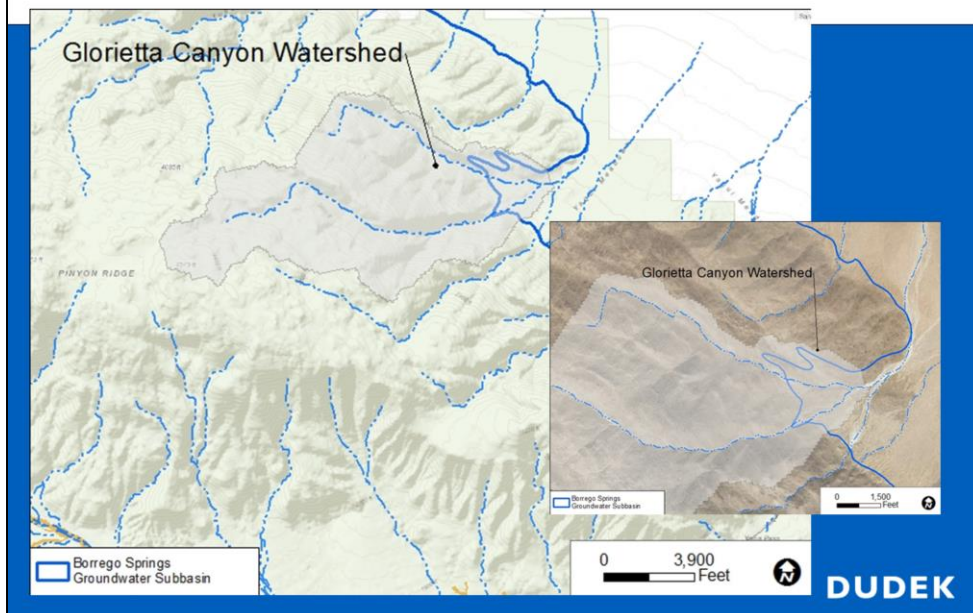
Three springs are mapped in the watershed and include Big Spring, Middle Spring and Tubb Canyon Spring (ABDSP 2017). In the vicinity of Big Spring, seepwillow, catclaw and mesquite have been identified (San Diego Reader 2010).

The satellite color-infrared photography indicates green, healthy vegetation as the color red (high reflection of near-infrared wavelengths). In a desert environment, the green healthy vegetation could represent a potential groundwater dependent ecosystem (GDE). A narrow band of habitat appears in the Tubb Canyon Creek channel primarily associated with the mapped springs.

Additional consultation should be conducted by the GSA with pertinent agencies to determine the potential for GDEs to occur in the Tubb Canyon watershed and whether this is a substantial nexus with groundwater elevations in the Borrego Springs Groundwater Subbasin.



## Glorietta Canyon



Glorietta Canyon is about a 1,852 acre watershed that discharges to the Yaqui Meadows area of the Subbasin.

No springs are mapped in the Glorieta Canyon based on the existing datasets (NHD and ABDSP).

The satellite color-infrared photography indicates limited vegetation associated with Glorieta Canyon, which seems to agree with the lack of mapped springs in the contributing watershed that would sustain a groundwater dependent ecosystem (GDE). Additional evaluation of Glorieta Canyon is required to determine the presence of potential GDEs.

## Questions

